

ELECTRIC FEED-THROUGH MOTOR

I. Field

[0001] The present invention pertains generally to the field of motors and electrical circuits, and more specifically to a motor for providing an electrical feed-through to a rotating object.

II. Background

[0002] Electric motors have been used for many years, for instance, to rotate antenna platforms. In many instances, antennas are mounted to a structure commonly known as a turntable. An electric motor is mounted underneath the turntable and attached thereto, and is used to rotate the turntable and, hence, the antenna, to maximize the antenna signal strength.

[0003] The turntable rotates with respect to the motor and any circuitry not located on the turntable. Hence, there is a need to couple electrical signals to the rotating antenna platform. Traditionally, this has been accomplished by use of a rotational coupler, which is a device that rotates with respect to fixed circuitry yet allows electrical signals to be transmitted from the fixed circuitry and onto one end of a rotating member of the rotational coupler. The other end of the rotational coupler is typically fixed to, for instance, circuitry located on the turntable.

[0004] The use of a rotary coupler typically demands that the motor be located off-axis from the central axis about which the turntable rotates. One or more belts, gears, or similar devices is used to couple rotational energy from the motor to a pulley attached to the turntable, thereby causing the turntable to rotate.

[0005] Generally, the location of the motor off-axis presents several problems. Often, there is limited space for a motor to be mounted anywhere in an antenna structure, so it becomes a challenge to fit all necessary electrical components and the motor onto the surface of the base. Locating the motor along the central rotating axis of the turntable would be ideal, however it is necessary to locate the rotational coupler in that particular area, due to the physical constraints of the rotational coupler.

[0006] Additionally, the reliability of such an antenna system is diminished somewhat, due to the use of the belt or gears, which can wear out, break, or slip in relation to the motor or the pulley to which it is attached.

[0007] What is needed is a way to locate the motor along the turntable central axis and attach it directly to a turntable, platform, or antenna, while still providing electrical signals to and from the turntable, platform, or antenna.

SUMMARY

[0008] An apparatus for providing electrical coupling, comprising a motor having a hollow, rotational shaft, and an electrical conductor located within said shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 illustrates an isometric, exploded, cutaway view of an antenna assembly using a feed-through motor;

[0010] FIG. 2 illustrates a close-up, isometric, exploded, cutaway view of one embodiment of the feed-through motor of FIG. 1; and

[0011] FIG. 3 illustrates the antenna assembly of FIG. 1, shown in a cross-sectional view.

DETAILED DESCRIPTION

[0012] The embodiments described herein are described with respect to an electric motor, commonly used to rotate antenna platforms. However, it should be understood that the motor could alternatively comprise any type of motor, including those driven by means other than electrical signals. In addition, the embodiments described herein may be used in applications other than antenna assemblies, such as in automotive applications, computer applications, or any other application where it is desirous to transmit an electrical signal to a rotatable platform.

[0013] FIG. 1 illustrates an isometric, exploded, cutaway view of an antenna assembly **100**, comprising motor **102**, antenna horn **104**, platform **106**, and circuit board **108**. Motor **102** is mounted against circuit board **108** and is used to rotate platform **106** and antenna horn **104** when assembled. Motor **102** comprises shaft **110** which, in one embodiment, comprises conductor **112**. One end of conductor **112** is electrically

connected to circuit board **108** while the other end of conductor **112** extends into a cavity formed by platform **106** and antenna horn **104** when assembled. Shaft **110** is connected to platform **106**, enabling platform **106** and antenna horn **104** to rotate about an axis around shaft **110**. Conductor **112** resides within shaft **110** and, in this embodiment, is not connected to shaft **110**. Therefore, conductor **112** remains stationary as shaft **110** rotates about its axis.

[0014] FIG. 2 illustrates a close-up, isometric, exploded, cutaway view of one embodiment of the feed-through motor of FIG. 1. In this embodiment, a semi-rigid coaxial cable **200** is housed inside shaft **110**. Shaft **110** is rotated about a central axis by an electro-magnetic force generated by exciting windings of motor **102**. Shaft **110** is additionally connected to platform **106** which in turn provides a bottom portion of a horn antenna assembly (not shown). Coaxial cable **200** extends past a top portion of shaft **110**, exposing coaxial cable **200** to a cavity formed by the platform **106** and the horn antenna assembly. The other end of coaxial cable **200** extends past a lower portion of shaft **110**, through motor **102**, and through circuit board **108** where it is electrically connected to electronic circuitry used to generate and receive high frequency electronic transmissions.

[0015] FIG. 3 illustrates the antenna assembly **100** of FIG. 1, shown in a cross-sectional view, including motor **102** in accordance with one embodiment of a feed-through motor. Motor **102** in this example comprises a stepper motor, however any type of motor could be used alternatively, including a D.C. brush or brushless motor, a servo motor, a brushless servo motor, and others, including motors that are driven by means other than electricity, such as a gasoline-powered motor.

[0016] As mentioned with respect to FIG. 1, the antenna assembly **100** comprises motor **102**, antenna horn **104**, platform **106**, and circuit board **108**. The antenna horn **104** rotates about an axis **300** as shown to allow it to maximize the signal strength of high-frequency signals received by antenna horn **104**. It should be understood that any other type of rotatable assembly could be used in place of antenna horn **104**, such as a circuit board for receiving electric signals through motor **102** or any other type of mechanical assembly.

[0017] Motor **102** comprises stator **202**, hollow shaft **110**, and, in one embodiment, conductor **112**. Shaft **110** is rotated with respect to stator **302** using principles well-known in the motion-control art. For example, shaft **110** may be rotated to any position

using motor-control circuitry (not shown) in accordance with generally-known stepper motor principles.

[0018] Shaft **110** comprises a hollow, cylindrical member, able to rotate with respect to stator **302**. Shaft **110** may be formed by drilling or by any other means known in the art. In one embodiment, motor **102** is constructed with conductor **112** located within shaft **110**. In other embodiments, motor **102** is constructed without conductor **112**, the conductor **112** inserted or otherwise introduced through shaft **110** during a later time, such as the mounting of motor **102** onto circuit board **108**. Conductor **112** functions to provide electrical signals from circuit board **108** to antenna horn **104**. For example, in one embodiment, shaft **110** comprises a conductor which is used to pass electrical signals. In the example of FIG. 3, one end of conductor **112** is connected to circuit board **108** by any convenient means, such as soldering. Alternatively, or in addition, conductor **112** is electrically coupled to circuitry located on circuit board **108**. The other end of conductor **112** extends into a cavity of antenna horn **104** and, in this embodiment, remains unconnected from any physical portion of antenna horn **104**.

[0019] In one embodiment, conductor **112** is not connected to shaft **110** so that conductor **112** remains stationary as shaft **110** rotates, and therefore antenna horn **104**, about axis **300**. In another embodiment, conductor **112** is affixed to shaft **110** and rotates along with shaft **110** around axis **300**. In this embodiment, at least one end of conductor **112** comprises a rotary coupling. For example, a rotary coupling is needed at the juncture of a signal source located on or within circuit board **108** (such as a circuit trace, microstrip, or waveguide coupler) and conductor **112**. In other applications where both ends of conductor **112** are connected to a mechanical structure, such as a circuit board, two rotational couplers are needed, one located at the juncture of a signal source located on or within circuit board **108** (such as a circuit trace, microstrip, or waveguide coupler) and one needed at the opposite end of conductor **112** where conductor **112** attaches to a mechanical structure, such as a turntable, platform, or directly to antenna horn **104**.

[0020] In embodiments where conductor **112** is affixed to the shaft and rotates therewith, conductor **112** may comprise a flexible, rigid, or semi-rigid coaxial cable. Such a coaxial cable typically comprises a non-conductive sleeve surrounding a conductor, dielectric, and shield. The sleeve may be held fixedly within shaft **110** by an adhesive, by press fitting, or by any other means generally known in the art. In an

embodiment where a non-conducting sleeve is not used, such as the case of some rigid or semi-rigid coaxial cables, the shield may be connected directly to the shaft from within, held in place by an adhesive, by press fitting, soldering, welding, or any other means generally known in the art. In still another embodiment, shaft **110** forms the shield of the coaxial cable, wherein a dielectric and center conductor are located within shaft **110**. In yet another embodiment, shaft **110** comprises a waveguide.

[0021] Conductor **112** comprises any electrical conductor known in the art including an insulated or non-insulated wire, a coaxial cable, a waveguide, or a combination thereof. Electrical signals carried by conductor **112** may comprise digital or analog signals, from D.C. to microwave frequencies and beyond.

[0022] The advantages of this design allows motor **102** to be located along an axis of rotation of platform **106**/antenna horn **104**, thereby freeing space on circuit board **106** for other components. In addition, one or more drive belts, used in applications where a motor is located off-axis, are eliminated, adding to the reliability of antenna assembly **100**.

[0023] The preferred embodiments of the present invention have thus been shown and described. It would be apparent to one of ordinary skill in the art, however, that numerous alterations may be made to the embodiments herein disclosed without departing from the spirit or scope of the invention. Therefore, the present invention is not to be limited except in accordance with the following claims.

WE CLAIM: